METRIC SYSTEM.

☛ See next No. for the Metric System and How to Teach it.

THE PRACTICAL TEACHER

A WEEKLY JOURNAL FOR MASTERS MISTRESSES AND STUDENTS

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☛ To PUPIL TEACHERS AND STUDENTS.

Crown 8vo. Extra cloth. PRICE 3s. 6d.

GIRLS' ARITHMETIC.

BY

A. C. DIXON, M.A., *Senior Wrangler, Fellow of Trinity College, Cambridge,*

AND

GEORGE BEACH, M.A., LL.D., *Head Master of the Higher Grade School, Macclesfield.*

DIXON and BEACH'S **GIRLS' ARITHMETIC** exactly meets in all respects the requirements of the New Circular (No. 297), issued February, 1891, by the Education Department.

[EXTRACT.]

Memorandum on the Training and Instruction of Pupil Teachers.

ARITHMETIC.

'The papers prepared by the Pupil-Teachers at the periodical examinations show that the teaching of Arithmetic leaves much to be desired. The arithmetical exercises have been too often limited to the working out of 'sums,' and have failed to **exercise the reason of the learners in connexion with the meaning and the theory of the rules employed.** More attention will now be needed to this important part of the teachers' training. In the "Instructions to Inspectors" (paragraph 25), those officers are enjoined "to ask the teacher of the class to give a demonstrative lesson." And it is added that **"he should so work out an example on the black-board as to make the reason for every step in the process intelligible and interesting to the scholars."** It is manifest that this requirement cannot be fulfilled in schools in which the Pupil-Teacher in his time of study is simply told to sit down and work exercises, and is not helped and guided by his teacher to a right **understanding of arithmetical principles.'**

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☛ SEE ALSO PAGES 126 & 127.

Quarterly Arithmetical Tests.

BY JOSEPH WOLLMAN,

Head Master of the Wellgate Board School, Rotherham.

Standard I.—First Quarter.

1. 27, 406, 81, 4, 290

2. 856 − 420

3. 798 − 345

4. A boy had 76 nuts, and he ate 54. How many had he left?

Second Quarter.

1. 514, 38, 9, 62, 785

2. 527 − 33

3. 614 − 508

4. There were 249 children in a school; 86 left and 95 were admitted. How many were then in the school?

Third Quarter.

1. 3, 908, 47, 659, 876

2. 134 − 56

3. 407 − 218

4. A shopkeeper had 500 eggs. He sold 76, then 158, and then 245. How many had he left?

Standard II.—First Quarter.

1. Take 28,307 from 56,702.

2. 289 + 3,605 + 47,003 + 9,478 + 54 + 60,720 + 396.

3. Multiply 57,859 by 46.

4. A gentleman had ten thousand pounds. He paid two thousand and eighty pounds for a house, and six hundred and forty-five pounds for furniture. How much had he left?

Second Quarter.

1. What is the difference between 876 and 10,023?

2. Find the product of 78,046 and 1,070.

3. Divide 31,620 by 4, and write the answer in words.

4. How many pages are there in 58 books, each containing 376 leaves?

Third Quarter.

1. What is the quotient of 71,064 and nine?

2. Subtract 38,029 from 43,216.

3. Multiply 27,398 by 689.

4. John has 49 marbles and Fred has 27 times as many. How many has Harry who has 18 times as many as Fred?

Standard III.—First Quarter.

1. Divide half-a-million by 59.

3. How often is 714 contained in 498,372?

3. In a division sum the quotient is 7,486, the divisor 590, and the remainder 254. What is the dividend?

4. There are 9 bags of nuts, each containing 247. If they are divided equally among 28 boys and 29 girls, how many will each child receive?

Second Quarter.

1. From £592 5s. 6d. take £67 14s. 9½d.

2. A cistern contains 580 gallons of water; how much would there be left after supplying 19 houses with 29 gallons each?

3 £483 19s. 10½d. + £90 17s. 4d. + £6 8s. 11¾d. + £3,057 13s. 9½d. + £824 16s. 3¼d. + £5,930 14s. 7¾d.

4. A man sold a horse for forty guineas, and made a profit of £8 16s. 9d. What did he give for the horse?

Third Quarter.

1. Find the sum of £40,607 10s. 9½d., £8,003 15s. 11½d., £590 8s. 7¾d., £19 19s. 6¼d., £6 17s. 10¾d., 12s. 2½d., and 8¾d.

2. How many pages could be made of 17,464 words, each page having 37 lines of 8 words each?

3. What must be taken from £47,006 14s. 6¼d. to leave £29,087 15s. 8½d.?

4. A sheep, goat, and pig cost seven pounds. The sheep and pig cost five guineas, and sheep and goat cost four guineas. What was the cost of each animal?

Standard IV.—First Quarter.

1. If one million seventy thousand three hundred and eight pounds seven shillings and a penny be divided into 460 equal shares, what is the value of each share?

2. Multiply £609 17s. 8½d. × 609.

3. What is the difference between 75 times £69 17s. 8½d. and 88 times £47 15s. 10¾d.?

4. A gentleman had £50. He spent £1 14s. 9d., and divided the remainder among 11 poor persons. How much did each receive?

Second Quarter.

1. Take ten thousand pence from 50 guineas, and give the answer in £ s. d.

2. Reduce 39 miles 5 fur. 5 chains 3 po. 5 yds. to inches.

3. Bring half-a-million square feet to acres, &c.

4. A grocer bought a ton of rice for £18, and sold it at 2½d. per lb.; what did he gain?

Third Quarter.

1. After buying as many ducks as possible at 3s. 9d. each, how much should I have left out of £7 18s. 6d.?

2. How many quarters, &c., are there in 57,928 packets, each containing 7 pints?

3. Bring 17¼ tons to stones.

4. The distance from the earth to the moon is about 240,000 miles. If it were possible to go there in a balloon, how many days would it take at the rate of 6¼ miles an hour?

A Course of Object-Lessons and Elementary Science.

(Adapted to the Syllabus of the New Code and of the London School Board.)

BY RICHARD BALCHIN.

Head Master under the School Board for London.

The concluding lessons for Standard I. comprise :—

SCIENTIFIC TERMS, ETC. :—SOLIDS, LIQUIDS, AND GASES.

29. Have on the table a flask, fitted with pointed tube, for boiling water ; a spirit lamp ; test-tubes and fragment of sulphur ; block of ice ; and a few fragments of iodine. Talk about the block of ice and a glass of water, and get from the boys the differences observable. Boil some water and note the vapour. Be content, at present, with these definitions of the three states, viz., a solid keeps its shape ; a liquid can be poured from one vessel to another ; a gas spreads about in the air. Do not make any reference to the attraction of cohesion. Heat some sulphur in a tube ; note first the liquid, then the vapour or gas. Heat some iodine ; note the vapour. Give numerous instances of the fact of solid metals being converted into a liquid state, and the use made of this : castings, refining, joining, etc.

WEIGHT.

30. Have ready a good pair of scales ; a set of weights ; a thin glass or beaker about six inches deep. The things necessary for making carbon dioxide (a heavy gas) and hydrogen (a light gas) ; a few odd pieces of stone and metal.

Let a boy come to the table and weigh some things. Then let him try to state the weight of objects and then weigh them. Weigh a pint of water—of course, after accurately weighing the containing vessel. So get the weight of a gallon of water. Weigh some oil or spirit to compare with water. If there is in the school the box of specimens of woods, and they are in blocks of equal sizes, let the boys come out and weigh them. Compare the weight of pitch pine with white deal, or oak with ebony, or mahogany with teak, etc. Make the boys wonder how 'air' or 'gas' can have weight ; or how one gas can be said to be heavy and another light. Make some heavy air, ex. carbon-dioxide. Do not give it this name ; call it a 'heavy air.' Get the glass beaker accurately balanced in the scales, then introduce some of the gas ; the boys will note the result. Make some hydrogen, call it 'light gas' ; turn the beaker upside down and, after accurately balancing the same, introduce the light gas. The boys will note the result.

EVAPORATION.

31. Have on the table some of the salt solution ; the sugar ditto ; and the wet filter papers containing the coloured compounds obtained in lesson 27. Water, and spirit-lamp. A little spirits of wine, and a flask with a pointed glass tube inserted in the cork, for boiling water.

Hold up some of the clear solution of salt in a test-tube. Again pass some through a filter paper. Liquid still clear, and tastes salt. No salt remains on the paper. Same with the sugar and water. Have a discussion with the boys as to what shall be done to get the salt and the sugar away from the water ; or the water away from them. Show a clean glass basin or watch-glass. Pour some salt solution into it and gently simmer over the spirit-lamp. Do the same with the sugar solution, but with less heat. In a few seconds the glasses are dry, but not clear as at first. Let a boy wipe a little of each off on his finger and taste it. Where has the water gone ? Lead on to evaporation. Now evaporate some spirits of wine. The change is more rapid than that of water. Pour a little spirit on to a boy's hand. Rub a little over another boy's brow. The sensation of cold is experienced. Do not attempt to explain this. Only note the fact. Boil some water and allow the steam to rush out of the pointed tube. At the conclusion of the lesson put some very strong solution of salt in a bottle, and let a string hang down into it from the cork. By the next lesson, salt crystals will have formed. Another way of obtaining the solid from its solution.

EXPANSION BY HEAT.

32. Have ready upon the table a brass ball which, when cold, will just pass through a circular aperture in a brass plate, a very small-bore glass tube having a large bulb at the end, several test-tubes, and water. Also a spirit-lamp and paper flour bag. Show that the brass ball, when cold, will pass through the aperture. Now hold the ball in the flame of the lamp or Bunsen burner. The ball will not pass. It has become larger. So lead to the term 'expansion.' Why larger ? What has caused the expansion ? All metals expand by heat. Notice the method of fitting on the iron tyres of wheels ; if possible, show a picture of this. Note also the process of riveting boiler plates together with red-hot rivets ; and that spaces must be left between the ends of the lengths of rails on a rail-road, etc. Show the expansion of liquids by heat. Pour a little red ink in a flask, and through the cork run a piece of glass tube which must dip into the liquid. Hold the flask over the lamp and note how the red liquid rises in the tube. Why is this ? Get one of the school thermometers and explain the principle upon which its action depends. Carry on a conversation about this expansion of liquids. Ask the boys which they think weighs the heavier, a pint of cold water or a pint of hot water. [While on this point, that irrepressible boy Powis, of whom I have already spoken, would insist upon believing that a pewter pot of hot water would, if quite full, weigh just as much as that same pewter pot when full of cold water, for, said he, 'that hot water there would make the pewter pot swell out (could not get him to use the word 'expand') so as it would hold a little more water than the cold pewter pot].

Show the expansion of gases, or air, by heat. Hold in the warm hand the glass bulb with the thin-bore tube. Then dip the end of the tube into some red ink in the ink well. Remove the hand and blow upon the bulb to cool it. The red liquid rises in the tube. Warm the bulb again ; the red ink is forced out. Let the boys come to the table and do this. Better not introduce the question of the cause of winds.

This completes the course of lessons in Elementary Science, or object lessons for Standard I. It will be seen that the scheme is really a continuation of the object teaching of a good Infant School, with the addition of a few lessons in what I may call Science proper. In the higher standards, the simple object lesson will gradually partake more and more of the character of a Science lesson, the intention being to lead up to Physics or Mechanics, and the chief phenomena of animal and vegetable life.

(To be continued.)

PUPIL TEACHERS' LATIN COURSE.

BY L. HUXLEY, B.A.,

Classical Master Charterhouse School.

This New Latin Course (specially written for Scholarship Candidates) was begun in our issue of February 7th (No. 4., vol. XI.).

EXERCISE IX.

1. Sed brūmā ădĕrat; ăquās glăciē tĕnēbat, ĕt in aquīs lĭburnās congĕlātās. 2. Super glăciem dūram ingressae cōpiae Gallĭcae, liburnās ĭtă glăciēi infixās occŭpābant. 3. Incŏlae cum jam nĕquĕ ēlŭvĭē victōriam, nĕquĕ lĭburnis rem frūmentārĭam compārārĕ possunt, Batāviam Gallīs postrīdiĕ, antĕ mĕrīdiem, mandant.

Translation.—1. But winter was at hand; it held the waters with ice, and the frigates frozen in the waters. 2. The Gallic forces, advancing over the hard ice, seized upon the frigates thus fixed in the ice (ind. obj.). 3. When now the inhabitants can neither obtain victory by a flood, nor supplies by the frigates, they hand-over Batavia next day, before noon, to the Gauls (dat.).

Retranslation into Latin.—1. The bear (*ursa*) once (*ōlim*) had a long (*longa-*) tail (*cauda-*). 2. But with excessive faith it obeyed (*pārē* with dat.) the little-fox (*vulpēcŭla-*), who (*quae*) advised (*suādē-* with dat.) the bear with show of friendship, but in reality (*re-vēra-* abl.) with bad (*mălla-*) faith. 3. For (*nam*) having fished (*piscāta-*) a long time (*diū*) with tail (abl.) let down (*dēmissa-*) into (*in* + acc.) the water through (*per* + acc.) the broken (*fracta-*) ice, it caught (*capi-ēbat*) nothing (*nīhĭl*). 4. But the tail, frozen with ice and stiff (*rīgĭda*), was broken off (*abrupta*).

O- STEMS.—Second Declension.

The following is the regular declension of substantives and adjectives (m. and n.) with o- stems.

Dŏmĭnus (m.), lord; bellum (n.), war; bŏnus (adj.), good.

		Masc.		Neut.	
		Subst.	Adj.	Subst.	Adj.
Sing.	N.	dŏmĭn-*ŭs*	bŏn-*ŭs*	bell-*um*	bŏn-*um*
	V.	dŏmĭn-*ĕ*	bŏn-*ĕ*		
	Acc.	dŏmĭn-*um*	bŏn-*um*		
	G.	dŏmĭn-*ī*	bŏn-*ī*	bell-*ī*	bŏn-*ī*
	D.Abl.	dŏmĭn-*ō*	bŏn-*ō*	bell-*ō*	bŏn-*ō*
Pl.	N.V.	dŏmĭn-*ī*	bŏn-*ī*	bell-*ă*	bŏn-*ă*
	Acc.	dŏmĭn-*ōs*	bŏn-*ōs*		
	G.	dŏmĭnŏ-*rum*	bŏn-*ōrum*	bell-*ōrum*	bŏn-*ōrum*
	D.Abl.	dŏmĭn-*īs*	bŏn-*īs*	bell-*īs*	bŏn-*īs*

Gender.—Neuters end in -um; the rest are masculine, excepting those in -us denoting trees, or Greek words, especially names of jewels and towns. Also *alvus*, paunch; *carbăsus*, linen; *cŏlus*, distaff; *hŭmus*, earth; *pampĭnus*, vine leaf; *vannus*, winnowing fan; *dŏmus* (also u- stem), house.

1. This declension alone has a separate form for the Voc. sing.
2. The locative ends in *ī* sing. and *īs* pl., as in names of places: Tarentī, at Tarentum; Pūtĕōlīs, at Puteoli (= Littlewells); and in a few other words, domī, at home (domŭs); humī, on the ground; and ănīmī, at heart; in such phrases as aegĕr ănīmī, sick at heart.

2. STEMS in io-.

Substantives from Voc. in ī, Gen. in ī or ĭī (the former regularly till the end of Augustus' reign). In the D. Abl. pl. īs for -ĭīs is sometimes found, especially from neuter substantives.

Adjectives keep *-ius* in the Voc. and do not contract in other cases.

Thus:		Subst.		Adj.
		fīlĭo- (m.), son	consĭlio- (n.), plan	ĕgrĕgio- (m.), excellent
Sing.	N.	fīlĭ-*ŭs*	cōnsĭlĭ-*um*	ĕgrĕgi-*us*
	V.	fīl-*ī*		
	Acc.	fīlĭ-*um*		ĕgrĕgi-*um*
	G.	fīl-*ī* (or fīlĭ*ī*)	consĭl-*ī* (or ĭ)	ĕgrĕgi-*ī*
	D.Abl.	fīlĭ-*ō*	consĭlĭ-*o*	ĕgrĕgi-*o*
Pl.	N.V.	fīlĭ-*ī*	consĭlĭ-*ă*	ĕgrĕgi-*ī*
	Acc.	fīlĭ-*ōs*		ĕgrĕgi-*ōs*
	G.	fīlĭ-*ōrum*	consĭlĭ-*ōrum*	ĕgrĕgĭ-*ōrum*
	D.Abl.	fīlĭ-*īs*	consĭlĭ-*īs* (or consĭlĭ*ĭs*)	ĕgrĕgĭ-*īs*

Decline like *fīlius; gĕnius*, familiar spirit, and all proper names in -ius: Lūcius, Caius, &c.

EXERCISE X. (O- STEMS.)

1. Equŭs et cervŭs ōlim dē pascuīs inter sē pugnābant. 2. Post longum bellum victŭs, ĕquŭs ăd vīrum sē rĕcĭpiēbat; auxĭlium rŏgābat. 3. Vir non rĕcūsābat; sĕd 'Prīmum' inquit 'frēnā ĕt hăbēnās impōnĕre ŏportĕt.' 4. Equŭs, ĭnīmīcum pūniendī cŭpīdŭs, nīhĭl rĕcūsābat. 5. Ităque vīr ĕt hăbēnās ĕquō impōnēbăt, et ipsĕ ĭn ĕquum ascendēbat. 6. Tum vīr cervum ĕ pascuīs exăgĭtābat; sed post victōriam, in ĕquum frēnīs dŏmĭtum, impĕrĭum tĕnēbăt.

Translation.—1. The horse and the stag once fought with one another about (their) pastures. (*Inter sē*, lit. among themselves.) 2. Defeated after a long war, the horse betook himself to a man; he asked for help. (*Sē*, acc. or abl. sing. or pl. of the reflexive pronoun.) 3. The man did not refuse; but 'First,' said he, 'it is necessary to put on (you) a bit and reins.' (*Inquit*, 3rd sing. pres. ind. of *inquam;* conjugated hereafter; *ŏportet*, impersonal verb; *frēnā*, a word generally used in the plural; the sing. is *frēnum*, but has two plurals, frēnā and frēnī [m.].) 4. The horse, eager for punishing his enemy, refused nothing. (*Pūniendī;* (1) punishing, a neuter verbal noun, called gerund, with the same construction as the verb; (2) the genitive dependent on the adj. *cupidus* is called the objective gen. because it answers to the acc. of the direct object after the corresponding verb *cupio*.) 5. So the man both put reins on the horse and himself mounted upon the horse. (*Vir*, nom. sing. [for declension, see below]; *ĕquo*, dat. ind. obj.; *in equum*, acc. because *ascendēbat* implies motion.) 6. Then the man drove the stag out of the pastures; but after (his) victory he kept his dominion over the horse, subdued by the bit.

Retranslate.—1. The stag drove the horse out of the pastures. 2. The man, riding (*vecto-*) on (*in.* + abl.) the horse, drove the stag into (*in*, with what case?) other (*alio-* adj.) pastures. 3. The horse, having obtained (*nacto-*) victory, nevertheless (*tămĕn*) was subdued by man. (See note Ex. III. 1.) 4. Man, by a cunning (*callĭdo-*) plan, exercised (*exerce-*) dominion over the horse. 5. So the horse, subdued by the bit, obeyed (see IX. Retran. 1.) man, and was a most faithful (*fidelissimo-*) slave (*servo-*).

(To be continued.)

Needlework for Pupil-Teachers.

BY MISS SOPHY LOCH,

Examiner of Needlework to the London School Board.

THE buttonhole (to which I have now come) is one of the most difficult parts of the garment. Some people seem to be born button-hole makers, but others appear to have great difficulty in acquiring the necessary regularity of stitch, and a garment otherwise very creditably turned out is often spoilt by the very inferior button-holes with which it is finished off. It is a good plan to practise button-holes a great deal before working one on the examination garment. The *cutting* of the button-hole is very important, as it is impossible to produce a really good one if this is faulty. Some workers always cut the slit with a sharp penknife, others prefer using scissors. A good way to prepare the cutting of the button-hole slit is to put the band flat on the table, measure the length required (viz., rather more than the diameter of the button), and mark it in its destined place with the point of the needle. If ordinary scissors be used, the band must now be doubled perfectly straight, and a little nick made with the scissors in the centre of the straight line marked by the needle, and the band then opened out again, thus:—

Fig. 14.

The scissors must now be inserted in the nick, and the rest of the button-hole cut, first in one direction, then in another. The button-hole is now ready for working. Should button-hole scissors be used to cut the slit, it is still a good plan to mark its position and length with the needle before cutting. When button-hole scissors are used, the band is of course held flat. As regards the position of the button-hole at the end of a band, care must be taken that it clears the turning-in of the latter.

The methods of treating the two ends of the button-hole are various, and it is entirely a matter of opinion whether the button-hole shall be made with two square ends, two round ones, or a square and a round one; whether the rounded end shall be worked with or without knots, &c., some people preferring two square ends as the stronger method, others one round and one square. Whichever be the method most preferred, however, by the worker herself, a button-hole with *both* ends had better be placed on the garment or specimen to be examined by the Education Department, that is to say, of course, where a rounded end is practicable. Two button-holes will be required on the chemise, one on the neck-band on the right hand side of the garment, with a round and a square end, and another on the front band, with two square ends, both button-holes running with the self-edge way of the material.

The arrow indicates the way of the self-edge.

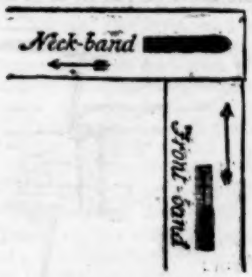

Fig. 15.

The points to be noted in making a button-hole are:—

1. If there is a round end, it must be placed *next the edge of the band.*

2. The cotton must be fastened on by the needle being run between the double material of the band, and brought out a little away from the edge of the slit on the left hand side. One or two stitches must be made to keep the cotton secure.

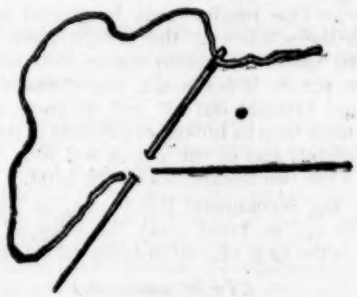

Fig. 16.

3. The cotton coming from the eye must be twisted round the point of the needle from left to right. If the reverse be done, the knot of the stitch is not correctly made. The cotton must always be kept to the back of the needle when the needle is put into the work.

4. The needle must be pulled out straight away from the worker when the knot is made, not to the right or to the left hand, in which case the stitch will of course be crooked.

5. The distance to be left between the stitches is the size of the cotton with which the button-hole is being worked.

6. In working a button-hole with a round and a square end, the side to the left of the round end is the one which must be first worked, then the round end, then the second side of the slit, and, lastly, the square end. In working a button-hole with two square ends, both sides must be made before either of the square ends are touched.

7. To prepare for the first stitch of the rounded end, the needle must be put in as in illustration:—

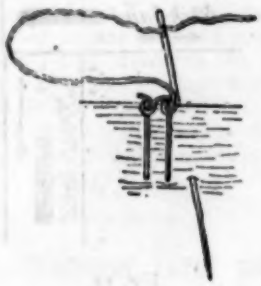

Fig. 17.

8. There should be nine stitches in the rounded end. The cotton must be pulled well home, and a good round be made.

9. In working the square end, eight or nine stitches should be made, and the knots be brought well up to the first and last stitch made on each side of the slit.

Should the worker be so unfortunate as to break her cotton in the middle of her button-hole, she must, after securely fastening on the fresh piece of cotton, bring it out through the knot last made. The final fastening off of the cotton is done in the following manner:—The needle must be passed in and out through the stitches at the back, a little backstitch made to make the cotton secure, the needle must then be put in between the two thicknesses of the band and brought out an inch or two away. The cotton must then be broken or cut close to the material. The unsightly end of the cotton will thus be hidden between the two thicknesses of the band.

I do not recommend the bracing of button-holes (as it is apt to break away the edge of the slit), except in the case of button-holes cut on the cross.

(To be continued.)

Publications Received.

NATIONAL SOCIETY'S DEPOSITORY.—Scholarship Questions, with Hints and Solutions, 1887—1890.

NELSON, T., AND SONS.—The Royal English History Readers, Standards II., III., and IV.; Royal Atlas Reader Text Books, Standards I. to VI.

NOVELLO, EWER AND CO.—Nine Kyries; Benedicite, Omnia Opera (*R. H. McCartney*).

NUTT, DAVID.—School German Grammar (*Eve*).

PHILIP, G., AND SON.—Child Life, No. 1., Vol. I.; Educational Annual, 1891.

SIMPKIN AND CO.—A Class Book of English History (*Curtis*).

SISSON, C. J.—Sisson's 'Rapid' Long Tot Roller; Sisson's 'Rapid' Arithmetic for Infants.

SMITH, ELDER AND CO.—The Cornhill Magazine—February.

STANFORD, E.—A short Geography of Asia *G. Johnston and Ravenstein*).

WHITTAKER AND CO.—Army Examination Papers in French (*Dr. Davis*); Graduated French Examination Course (*Barbier*).

WILLIAMS AND NORGATE.—A Practical Spanish Manual (*Hardy*).

NEW DICTATION TESTS.

DICTATION TESTS FOR STANDARDS IV. AND V.

(*Previously unseen.*)

HE observed a number of children busily engaged in making mud designs. The children were so happy and pleased that the minister spoke to them and asked some questions about what they were doing. He found that they were making a church; and the various parts, the pulpit, pews, and galleries were pointed out. He then asked one of the little boys, just to try his wit, 'But where is the minister?' The boy thought for some seconds and then replied, 'We had not mud enough to make one.'

***

A HORSE and a donkey on neighbouring farms formed a close friendship with each other, and became inseparable companions. They used to wander about together, the horse leading the way and the donkey following. Their wanderings became very troublesome, for often they went far away, and were found only with difficulty. When the horse was not working and was out in the fields, it was blindfolded to prevent it taking the lead.

This stopped their wanderings for a little, but it was soon found that they had again begun to stray from home.

***

ONE evening while his army lay in camp the enemy made a night attack. They broke through all the guards, and coming upon the Prince's tent, killed two of his secretaries —the Prince himself escaping very narrowly. On the field of battle he always lay in arms, and a servant was ready at hand with a horse. His little dog, hearing the noise, by its scratching and whining awoke him, and he had just time to reach the saddle and escape before the enemy came up. He often said that but for the little dog he would have been either taken or slain; and he always kept a dog of the species to show his gratitude.

***

A GALLANT regiment, ordered home from the West Indies after twenty years' service, was landed and stationed in barracks at Plymouth. Since it had left England many changes had taken place, and the regiment was looked upon, now that it was in its native country, as being far from a smart one. The officers and men had grown so stout that the general in command despaired of ever smartening them up. Of the men he had some hope, but of the officers he had none, and he tried to induce them to resign, which they refused to do and the matter was referred to headquarters.

***

SOME children playing on the banks of a stream in North America found a bright yellow stone. It was very heavy, but as the boy who discovered it was unwilling to part with it, he got his brothers to assist him in carrying it home. Their father set no value on it; he wanted food and clothing, and did not care for stones. He told his sons to place it as a prop against the lockless door, and thus for some years it served the purpose of keeping the door open by day and shut by night.

***

SHORTLY after the train got in motion the Frenchman seated himself opposite the schoolmaster, and for some time kept looking steadily at him. The schoolmaster was puzzled at this conduct, but was somewhat alarmed to see the Frenchman draw from behind him a large sheath-knife, which he commenced to sharpen on his boot. Our friend imagined that he was in the company of an escaped lunatic who intended to kill him, and he gave himself up for lost. He was much relieved, however, when the Frenchman, opening a bag, produced from it a loaf and a piece of cheese, which he proceeded to eat.

Publications Reviewed.

The Civil Service Series: The Essay Writer.

By Henry Skipton. Second Edition, with New Introduction. London: Crosby, Lockwood and Son.

The student who wishes to practise essay-writing may find in this book a certain kind of help. It will provide him with a stock of material for essays, but the assistance it is likely to give in the actual composition of the essays is very slight, and is not altogether to be trusted. The author has collected abundant information on current topics and subjects of various kinds, and arranged it in eighty outlines or skeletons, some of them being very elaborate; but he does not supply a single example of the finished essay. The introduction contains a number of hints, but, beyond the advice to read good literature, these are of no great value. Even the models the author recommends for study and imitation are so jumbled together that he finds it necessary to add cautions and qualifications which are too vague and general to be really useful. 'As models for style we may mention the Bible, Addison, Swift, Macaulay, J. R. Green, and the leading articles of the *Times* and *Daily Telegraph*.' He then explains that in mentioning the last of these, 'he has chiefly in view the humorous essays of Sala, and the leaders on matters connected with sport and the history of the turf.' The easy-going garrulous articles of Mr. Sala make pleasant light reading, but the candidate who tries to imitate them is hardly likely to produce good essays. Mr. Skipton warns the student against some of the most glaring of blunders, is over fastidious in his objections to some expressions allowed by high authorities, and then falls into some of the worst mistakes himself. Thus he says, 'Place adverbs next the words they qualify,' and on the next page we find, 'say what you think straightforwardly,' where he evidently means, 'say straightforwardly what you think.' He gives a quite passable collocation of phrases as an example of mixed metaphor, and in one of his outlines talks of placing 'all elementary education in *the hands of Board schools*.' He objects to the sentence, 'He has the courage of his convictions,' but on the same page he says, 'Metaphor is a rather sharp-edged tool to play with for a beginner.'

He attaches great importance to 'system,' and suggests that in essays 'all headings should be underlined, and we should generally try to catch the eye.' He adds, 'we must not, however, imitate the vulgar Yankee methods of the *Pall Mall Gazette*, the *Star*, and the *New York Herald*.' He recommends his 'George II.' and 'George III.' and Tait's 'Analysis of Green's History,' as 'examples worth imitating.' As summaries they may be, but not as essays, excellent as we know the last-named work to be in its own kind.

We should advise the student to content himself with gaining information and suggestions for matter from our author's 'skeletons,' and to seek elsewhere for guidance in the art of essay writing. In many cases the outline is much too long for an examination essay, some extending in the condensed form to six or eight pages of the text book.

Illustrations of Trades. Edinburgh and London: W. and A. K. Johnston.

This departure in illustrative work has been capitally carried out. In the samples now before us the two trades dealt with are the Printers' and the Hatters'. Each calling is illustrated in a very practical manner, and an exposition of many of the technical terms used in the trade is given in the explanatory letterpress appended. Thus, in the plate illustrative of Printing, we see the compositors 'setting up' the type, and we are shown pictorially the reason why we use the letters '*l. c.*' (lower case) when we correct a proof and wish to indicate that capital letters should be changed to small. Other mysterious words and phrases, such as 'stick,' 'galley,' 'shooting-stick,' 'locking-up,' &c., are clearly illustrated; and, besides giving a drawing of the kind of printing-machine which turns out ten or twelve thousand newspapers per hour, the plate also affords a glimpse of the Lithographic branch of the Printer's trade.

The sheet illustrating the manufacture of Silk Hats is equally practical; and from the information afforded by the operations of the workers represented, by the state of the various hats in the foreground of the picture, and from the explanatory letterpress underneath, a very fair idea can be obtained of the different stages passed through by an ordinary 'chimney-pot' hat during the process of manufacture.

We believe that plates of the above description are of great value as incentives, calculated to lead children's minds to favour particular callings. Many a youngster, who would otherwise drift on through life as a miserable unit of the great army of the 'unskilled,' might, through the quickening impulse of a plate of this kind, so have his volitions strengthened as to be led to adopt one of the trades illustrated, and thus eventually become one of those skilled workers who have done (and are doing) so much to uphold British industries in all parts of the world.

The Tutorial Series: A History of England, 1685—1801. By A. J. Evans, M.A., and C. S. Fearenside, M.A. London: W. B. Clive & Co.

Two of the accomplished tutors of the University Correspondence College have given us in this volume a very meritorious text-book on a special period of English history, appointed for a coming examination. The Introduction consists of a sketch, in broad, rapid, and vigorous strokes, of our country's story previous to 1685, with reference, more especially, to constitutional changes and international relations. The chapters which follow treat the important events of the period in a concise and readable style, and give quite sufficient detail for the general student. A large part of the book is occupied with political questions and with the relations of England with continental powers. Admirable attempts are made to disentangle the intricacies of the War of the Spanish Succession, and the War of the Austrian Succession in which so many of the European nations were involved. The American War of Independence is also ably treated.

The last two chapters are devoted respectively to events relating to India and to Ireland. In the former the mass of detail is perhaps too great for a narrative so condensed to be interesting. Ireland is dealt with briefly but clearly, and on the whole impartially.

We note the apt method adopted in many cases of comparing the events of the period with others of our own times, as the Darien Scheme with recent attempts to make the Panama Railway and the Panama Canal.

A few slight misprints occur in the volume. Thus we are told of Charles II., that 'he was debating whether to summon a Parliament, or chance it, when, in February, 1689, he died, and was succeeded by his brother.' Here the date of course is wrong, and the inelegant phrase 'chance it' we have usually regarded as a cockney vulgarism. The spelling Hannover and Hannoverian with a redundant *n* appears pedantic and unwarranted; but these are trifling blemishes in an admirable text-book.

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BY

E. G. BAKER, B.SC., B.A.,

Vice-Principal of the Training College, Carmarthen.

EXERCISES.—Scale ½ in. to 1 ft. Height of spectator's eye above the ground plane, 6 ft.; distance of spectator from the plane of projection, 10 ft.

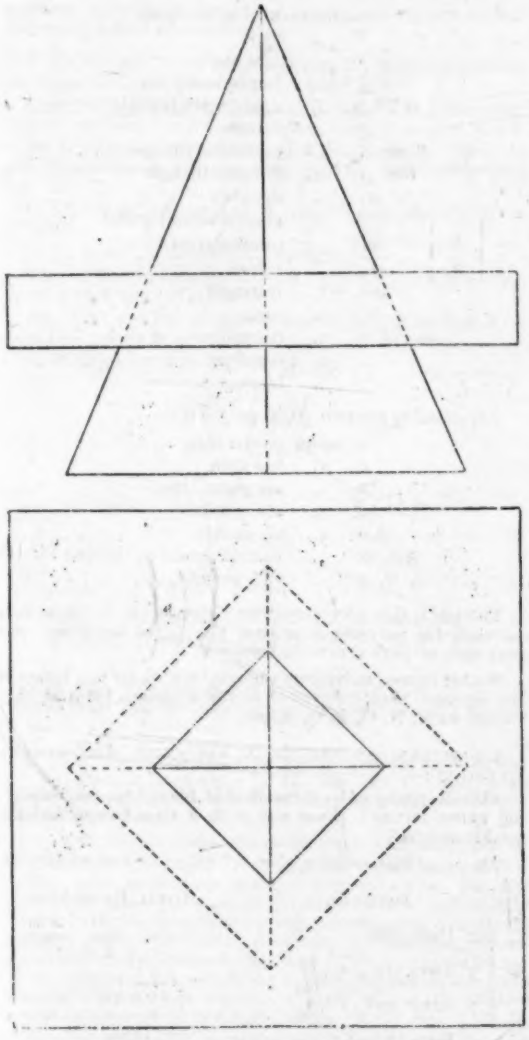


Fig. 72.

1. Project the pyramid and slab, of which the plan and an elevation are given in fig. 72, supposing the centre of the base of the pyramid to be on the ground plane 2 ft. to the left and 4 ft. in the picture, and two sides of the base to recede from the picture plane towards the left at an angle of 20°.

Place the plan of the pyramid in position as directed for fig. 71. The vanishing points for the pyramid had better be those for one diagonal and one side of the base, as they will be nearer the centre of the picture plane.

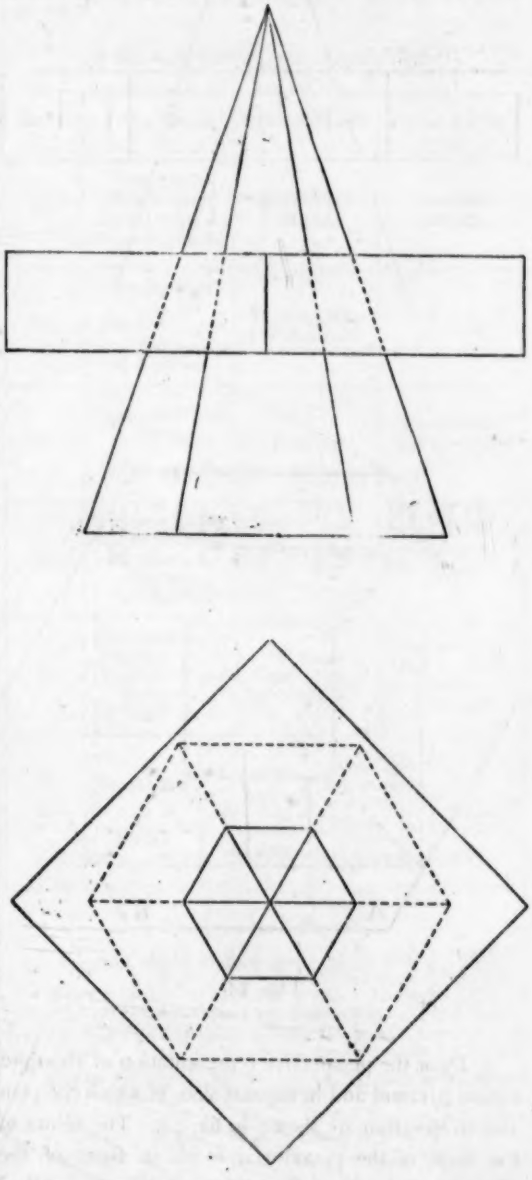


Fig. 73.

2. Project the slab and pyramid shown in fig. 73, the nearest angle of the square slab to be 2 ft. to the left and touching the picture plane, two of its vertical faces making an angle of 50° with the picture plane towards the right.

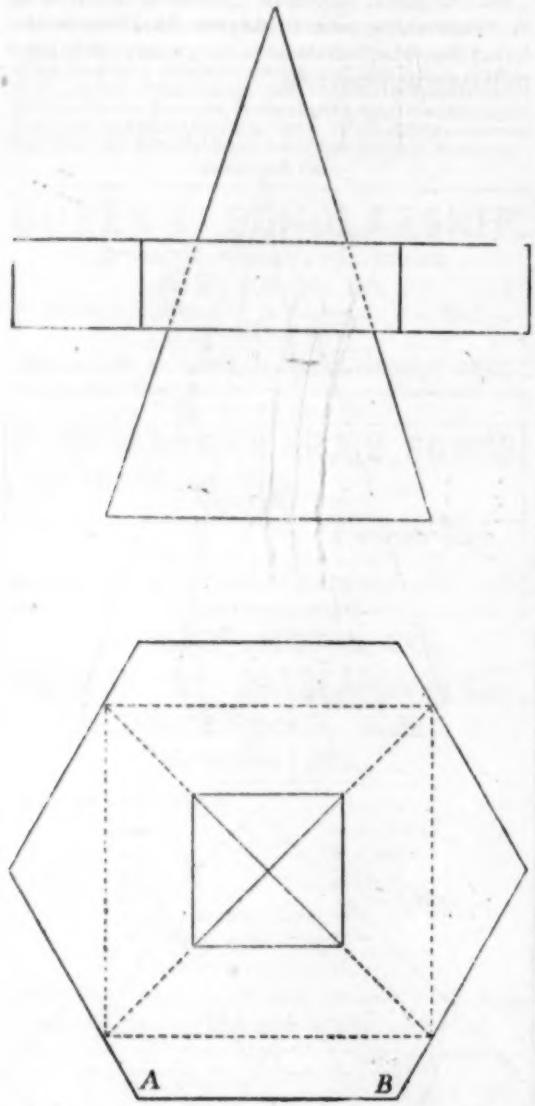


Fig. 74.

3. Draw the perspective representation of the right square pyramid and hexagonal slab, of which the plan and an elevation are shown in fig. 74. The centre of the base of the pyramid is to be in front of the spectator and 4 ft. in the picture, and the face AB of the slab is to recede from the picture plane towards the right at an angle of 40°.

(To be continued.)

—o—

The 1891 Scholarship Examination.

BY DR. GEORGE BEACH, M.A.

Co-Author of 'A Manual of our Mother-Tongue,'
Author of 'Elements of English,' 'Entertaining Readers.'

1. Complying with the request of several subscribers, we shall endeavour in the remainder of these Articles to meet the requirements of the SCOTCH Code, as well as of the English. In truth, the difference between the two is not great.

2. The *following* is the list of abbreviations and signs which Mr. OAKELEY, H. M. I., says will be allowed in Euclid :—

=	*means*	equal to, or equals
$\angle$	,,	angle
rt $\angle$	,,	right angle
$\perp^r$	,,	perpendicular
rt $\angle^d$ $\triangle$	,,	right-angled triangle
$\triangle$	,,	triangle
Equil. $\triangle$	,,	equilateral triangle
Isos. $\triangle$	,,	isosceles triangle
str.	,,	straight
$\parallel$	,,	parallel to, or parallel
$\boxed{\text{m}}$	,,	parallelogram
sq.	,,	square
rect.	,,	rectangle
$\odot$	,,	circle
circ. of $\odot$	,,	circumference of circle
$\therefore$	,,	therefore
$\because$	,,	because

The following SHOULD NOT BE USED :—

>	*means*	greater than
<	,,	less than
$\not>$	,,	not greater than
$\not<$	,,	not less than
AB^2	,,	sq. on AB
AB . BC	,,	rect. contained by AB and BC
+, −, ×, ÷	,,	add, subtract, etc.

The rule is that ANY *descriptive* abbreviation of TERMS may be used, but not ambiguous ones (*e.g.*, $\angle$ = less than) ; nor may signs of OPERATIONS be employed.

Neither figures, manuscript capitals, nor the leading letters of the alphabet must be applied to the diagrams, but such characters as M, N, O, P, Q, R, etc.

3. SPECIMEN ANSWER OF A FAVOURITE DEPARTMENT QUESTION :—

'Divide 359 by 42 by the method of Short Division, employing PRIME factors? Show also as to a class how to find the total remainder.'

The prime factors are 2, 3, 7.

DIVISION.			TOTAL REMAINDER.
42	2	Units 359 — unit	3 2 sixes twos units 3 — 2 — 1
	3	Twos 179 — 1 — twos unit	3 11 twos
	7	Sixes 59 — 2 — 1 — sixes twos unit	2 23 Units
		Forty-twos 8 — 3 — 2 — 1	

4. A CATCHY MENSURATION QUESTION :—

'The sides of a triangle are in the ratio of 13, 13, 10. If its area be 3,840 sq. yards, find the length of each side.'

Area of a triangle whose sides are 13, 13, 10 yards } = $\sqrt{18 \times 5 \times 5 \times 8}$ sq. yards = 60 sq. yds.
(N.B. 18 = half sum of the sides.)

Now the similar sides of similar triangles are to one another as the square roots of their areas.

In other words, as the area of the larger triangle is $\frac{2}{10}$ of the smaller, the sides of the larger will be $\sqrt{\frac{2}{10}}$ of the smaller, *i.e.*, 8 times the smaller.

Thus the sides of the larger will be 13×8 yards, 13×8 yards, and 10×8 yards, etc.

We regret to say that we inadvertently forwarded a wrong solution to an *unknown* correspondent, and we hereby ask him to rectify it.

5. Many of our readers misinterpret the following kind of question :—

'Write down the compound verb forms which are equivalent to—*arise, penetrated, defer*, etc. These are *get-up, went-through, put-off*, etc.

6. ARTICLE 41F of Code is variously understood. As it is so important, we are in correspondence with the Education Department upon the matter; have already received two replies, and expect a final answer shortly.

7. AB bisects CD at right angles at B; P is a point within the angle ABC, and CP produced cuts AB at E.

Show that the difference between ED and EP is greater than that of any other two lines drawn from P and D to meet in AB.

Let DA and PA be two other lines meeting in A. Then the difference between ED and EP is greater than between DA and AP.

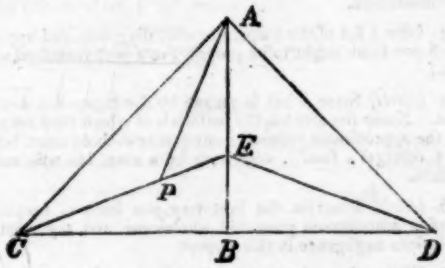
∵ EB and BC are respectively = to EB, BD, and ∠ CBE = ∠ DBE,

∴ EC = ED. Similarly AC = AD.

Then difference between ED and EP = CP, and the difference between AD and AP = AC less AP.

But ∵ AP and PC are greater than AC, from each of these take PA.

∴ PC is greater than AC less AP, etc.



N.B.—The student should note that we have *en passant* proved that 'The difference between any two sides of a triangle is less than the third side.'

8. In describing the view from a lofty mountain peak [A PET QUERY] there is large scope for the examinee to display comprehensiveness of grasp, breadth of knowledge and picturesqueness of description.

In what order would the multifarious and multitudinous objects beneath strike the eye and arrest the mind?

The most magnificent features would occupy the first astonished gaze—the stupendous elevations—the precipitously bounded valleys—the opening plains extending wide—the slowly crawling glacier—the rushing avalanche—the headlong cataract—and the winding and widening silver of the rivers. Here and there, towns and cities would dot the horizon, and as the lesser features attracted the attention the colours of the various mountain zones would ravish the vision.

In turn, as the eye descended the slope, an ever-changing panorama would be revealed. The desert ice and snow of the summits, regions of eternal cold, barrenness, solitude, silence, and death would gradually yield to the lichened and moss-clad rock.

Then would insensibly succeed rhododendrons and grasses (whereon the hardy goat browses), only to give place imperceptibly to the long-lived forests of towering pines, the habitat of bears. Next would appear the perennial evergreen, and the trees of a temperate clime, whilst an ever-increasing variety of fauna would enliven the scene.

Should we now be located in tropical lands, the pleasant myrtle, the cheering vine, and the renowned laurel would clothe the declivities, until near the mountain foot the fig and tree-fern would rear their heads aloft.

Right at the base the succulent banana and the feathery palm would present themselves, rising from amidst gorgeously coloured vegetation; throughout the surrounding plains would roam the royal tiger, the lordly lion, the mighty rhinoceros and the majestic elephant, and in the immense rivers would sport the uncouth hippopotamus, and would lie in wait the malignant alligator.

WEEK COMMENCING 9TH MARCH 1891.

DAYS.	FIRST HOUR.	SECOND HOUR.	THIRD HOUR.
M.	Simultaneous Equations of First Degree *or* Rules for Health	From 1813 to 1820	Latin *or* French
TU.	Euclid up to I. 34, *or* Sectional Paper Diagram of Chemise	Physical Map of Australia	Science
W.	Square and Cube Roots. Proportion	Drawing	Composition and History of English
TH.	Problems leading to Simultaneous Equations, *or* Clothing and Washing	From 1820 to 1830	Latin *or* French
F.	Deductions up to Euclid I. 34, *or* Sectional Paper Diagram of Night Shirt	Physical Geography of Australia	Paraphrasing and Table of English Literature
S.	Mensuration. Stocks	Repetition and Macaulay's Essay on Addison	The Code requirements for the Standards. How to teach writing / Science

REMARKS ON ROUTINE.

(*a*) SIMULTANEOUS EQUATIONS.

Hamblin Smith—(1) pp. 142 to 144. Examples LXX. to LXXVII., sums 1 and 9 in each; (2) p. 154 and Note I. p. 157, Note II. p. 159, Note III. p. 160, together with sums 1, 9, 24, 25, 36, 37, 43, 44 of Example LXXVIII.

Charles Smith—(1) pp. 72, 73, 74, 75, Articles 88, 89 and 90, together with Examples XVIII. and XIX., sums 1 15 in both; (2) pp. 83, 84, 85 and Example XX., sums 1 and 6, also Example XXI., sums 1, 5, 9, 13.

Todhunter—(1) pp. 136 to 142, Examples XXIII. and XXIV., sums 15, 16, 17 in both; (2) pp. 150 to 154, Example XXV., sums 1, 5, 9, 13.

(*b*) EUCLID.

Deighton (1) pp. 53 to 58; (2) pp. 55, 56, 58, Exercises 2 and 3 in each.

Todhunter—(1) pp. 35 to 38; (2) Exercise on pp. 343, 344, Nos. 45, 49, 52, 53, 57, 59.

SCOTCH CODE.—First nine propositions of Book III. in addition.

(*c*) ARITHMETIC.

Pendlebury, pp. 299 to 304, Examples CLXXXV. to CLXXXVIII., sums 8 and 9 in each.

Dixon and Beach—(1) Study pp. 121 to 129. (2) Any sums on pp. 190 to 192. } *Females.*

Hamblin Smith, pp. 99 to 104, Examples LVII. to LIX., sums 1 and 12 in each.

Barnard Smith, pp. 274 to 281, Example LXIX, sums i. 1, iii. 1, and iii. 3.

(*d*) MENSURATION.

Todhunter, pp. 45 to 54, Examples VIII. and IX., sums 4 and 7 in each.

(*e*) HISTORY.

Sanderson—(1) pp. 357 to 371; (2) pp. 371 to 375 and revision.

Ross—(1) pp. 415 to 423; (2) pp. 423 to 430.

SCOTCH CODE.—The Saxon Conquest and the Heptarchy.

(*f*) GEOGRAPHY.

(2) Read carefully pp. 189 to 196, *Moffat and Paige*; (2) Study carefully pp. 200 to 204, *Anderson*.

SCOTCH CODE as English, with Physical Geography of Mountains.

(*g*) ENGLISH.

(1) Composition on '*Colonisation*.' Revise pp. 165 to 172 of *Beach's* '*Elements of English*.' (2) Revise pp. 177 to 179, and answer Question . . . .

(*h*) LATIN.

Read *Mr. Huxley's Article*, and first six chapters of '*De Bello Gallico*.'

FRENCH.

Professor Darquet's Course, pp. 62 to 71, and '*La Jeune Sibérienne*,' pp. 12, 13, 14.

Upon proof that there is a demand for it, we will insert specimen translations of the Latin and French authors.

(*i*) SCHOOL-MANAGEMENT.

Gladman, pp. 59 to 70, and Schedule I. of New Code.

(*j*) HUGHES' DOMESTIC ECONOMY.

(1) Collect a dozen common-sense rules, the observation of which will tend to preserve health.

(2) Pages 377 to 409. This will be set again.

SELECTED GOVERNMENT QUESTIONS.

(*On portion of work already traversed.*)

1. Solve the equations—

(*a*) $\frac{2y-25}{3} - \frac{6-x}{7} = \frac{2(y-7)}{5}$

$\frac{29-x}{8} - \frac{3y-1}{10} = \frac{4-x}{3}$

Ans. $x = 13$. $y = 17$.

(*b*) $\frac{3x+1}{7} - \frac{2x-y}{2} = \frac{2y-x}{8}$

$\frac{4x-2}{3} - \frac{4y-5x}{2} = \frac{x+y}{5}$

Ans. $x = 2$, $y = 3$.

2. In a factory there are 62 workmen, and the total amount of their weekly wages is £74 6*s*. A certain number of them receive 40*s*. a week, twice as many receive 29*s*. 6*d*. per week, and the rest 17*s*. Find the number receiving each rate of wages.

Ans. 9, 18, 35.

3. If any side of a triangle be produced, the exterior angle is equal to the interior and opposite angles; and the three interior angles of every triangle are equal to two right angles.

PQR is a right-angled triangle; from the right angle R, RS is drawn bisecting PQ at S, and RT at right angles to PQ meeting it at T. Show that the angle SRT is equal to the difference of the acute angles at P and Q.

4. The diameters of the wheels of a bicycle are 48 and 14 inches respectively. Show how many more revolutions the small wheel will make than the large wheel in a distanc of 10 miles ($\pi = 3\frac{1}{7}$).

Ans. 10,200.

5. Three bells toll at intervals of 12, 15, and 28 seconds respectively. A person at a distance from them can hear their sound only when two at least toll at the same time. If they begin together, how many times will he hear their sound in seven minutes?

Ans. 11 times.

6. Two men own adjoining farms of 360 and 540 acres respectively. They unite the farms and take a partner who pays them £2,000 on the understanding that a third share of the land shall in future belong to each. How is the £2,000 to be divided between the original owners?

Ans. £400 and £1,600.

7. For what are the following dates memorable:—1815, 1827, 1830?

Give the dates of Declaration of American Independence, Commencement of French Revolution, and the Battle of the Nile.

8. What do you know of the Catholic Relief Acts?

9. What is the Commercial policy of the United States, and what is the Monro doctrine.

10. Compare the Eastern, Western, and Southern States of America (U.S.) as to (*a*) Climate, (*b*) Occupation, and (*c*) Population.

11. Explain the meaning of each of these terms, and make sentences illustrative of their use:—*Passive, Antithesis, Co-ordinate, Apposition, Infinitive of Purpose, Demonstrative, Ellipsis.*

12. Take the following words:—*for, because, therefore, since, as, but.* Place each of them so that it shall serve to introduce a Subordinate Sentence, and say in what relation this sentence stands to its Principal Sentence.

13. Give a plan of the school-room, class-room and play-ground of the school with which you are best acquainted. Give the dimensions also, and say for how many scholars it provides accommodation.

14. Give a list of the maps, pictures, diagrams and apparatus which you think ought to be provided in a well-furnished school-room.

15. (*Girls*) State what is meant by the expression *household linen*. Name the articles, the materials of which they are made, and the approximate value of a stock of household linen, suitable for a cottager's family, consisting of a man, his wife and two children.

16. (*Girls*) Describe the best way you know of keeping the air of a school-room pure and wholesome, and say what evils result from negligence in this respect.

17. Write a Largehand copy of 'Alleghany Mountains.'
" Smallhand " 'Ill-gotten gains quickly fly.'
" Roundhand " 'Freedom is sweet.'

SCOTCH CODE.

18. Give particulars of the Saxon Settlement in Scotland.

19. Briefly describe the River System of Hindostan.

20. Two points in the diameter and equi-distant from the centre of a circle are taken. If these be joined to any point of the circumference, show that the sum of the squares on the sides of the resulting triangle is constant.

CORRESPONDENCE.

1. CONSTANT READER.—From 1688 to present time, but questions may be asked upon the whole history.

2. NEVERTHELESS.—Your question respecting Article 41*f* you will find answered by New Code alteration.

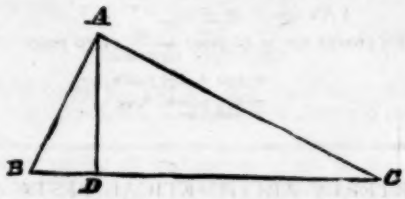
3. DONALD.—Nearly coincident, but the differences are not neglected.

S. MEARS.—Yes, the *Teacher's Notes on Drawing* will shortly re-appear in our pages. We beg to remind several correspondents that it is impossible to give instalments of all our articles *every* week. [Ed. P. T.]

Query Column.

Mensuration.

1. STUDENT.—A perpendicular 10 chains long from the right angle of a right-angled triangle on the hypotenuse divides it in the ratio of 1 : 4. Find the lengths of the two sides. (*Hiley.*)



$AB^2 = AD^2 + BD^2$
$AC^2 = AD^2 + CD^2$
$AB^2 + AC^2 = 2AD^2 + BD^2 + CD^2$
$BC^2 = 2.10^2 + BD^2 + (4BD)^2$
$(5BD)^2 = 200 + BD^2 + 16BD^2$
$25BD^2 = 200 + 17BD^2$
$25BD^2 - 17BD^2 = 200$
$8BD^2 = 200$
$BD^2 = 25$
$\therefore BD = 5.$

$\therefore$ Hypotenuse $= (5 \times 5)$ chains
$= 25$ chains;
One side $= \sqrt{10^2 + 5^2}$ chains
$= \sqrt{125}$ chains
$= 11{\cdot}1803\ldots$chains;
Other side $= \sqrt{10^2 + 20^2}$ chains
$= \sqrt{500}$ chains
$= 22{\cdot}3606\ldots$chains.

Algebra.

1. JUGURTHA.—Find four numbers in Arithmetical Progression whose sum is 36 and product 3465. (*Colenso.*)

(1) $a + (a + d) + (a + 2d) + (a + 3d) = 36$
$4a + 6d = 36$
$2a + 3d = 18$
$2a = 18 - 3d$
$\therefore a = 9 - \frac{3d}{2}.$

(2) $a(a + d)(a + 2d)(a + 3d) = 3465$
$\left(9 - \frac{3d}{2}\right)\left(9 - \frac{3d}{2} + d\right)\left(9 - \frac{3d}{2} + 2d\right)\left(9 - \frac{3d}{2} + 3d\right) = 3465$
$\left(9 - \frac{3d}{2}\right)\left(9 - \frac{d}{2}\right)\left(9 + \frac{d}{2}\right)\left(9 + \frac{3d}{2}\right) = 3465$
$\left(81 - \frac{9d^2}{4}\right)\left(81 - \frac{d^2}{4}\right) = 3465$
$6561 - \frac{810d^2}{4} + \frac{9d^4}{16} = 3465$
$\frac{9d^4}{16} - \frac{405d^2}{2} = 3465 - 6561$
$= -3096$
$d^4 - 360d^2 = -5504$
$d^4 - 360d^2 + (180)^2 = 32{,}400 - 5{,}504$
$= 26{,}896$
$d^2 - 180 = \pm 164$
$d^2 = 180 \pm 164$
$= 16$ or 324
$\therefore d = 4$ or $18.$

The second value is inapplicable.

(1) $2a + 3d = 18$
$2a + 12 = 18$
$2a = 6$
$\therefore a = 3.$
$\therefore$ Series $= 3, 7, 11, 15.$

2. JUGURTHA.—Solve:—
$\sqrt{x} + \sqrt{a - x} = 2[\sqrt{x} - \sqrt{a - x}].$ (*Colenso.*)
$\sqrt{x} + \sqrt{a - x} = 2[\sqrt{x} - \sqrt{a - x}]$
$\sqrt{x} + \sqrt{a - x} = 2\sqrt{x} - 2\sqrt{a - x}$
$\sqrt{a - x} + 2\sqrt{a - x} = 2\sqrt{x} - \sqrt{x}$
$3\sqrt{a - x} = \sqrt{x}$
Squaring] $9(a - x) = x$
$9a - 9x = x$
$9a = 10x$
$\therefore x = \frac{9a}{10}.$

3. SUNNYSIDE.—A person borrows £97½ to be repaid by 36 monthly instalments of £3 each. (Amount repaid equals £108 made up of capital and interest.) Find rate per cent. per annum.

We will take the question at simple interest, as compound interest is not stated.

Let P denote the amount borrowed in pounds, A the amount of a monthly payment in pounds, r the interest per month of one pound, and n the number of payments.

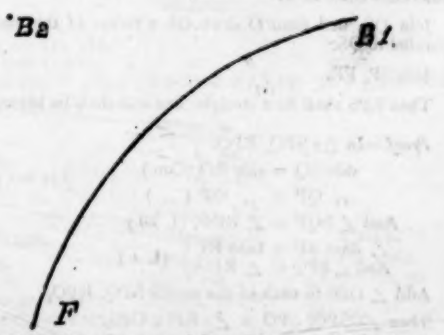
Then $P = \frac{nA + \frac{1}{2}n(n-1)rA}{1 + nr}$
$\therefore 97\frac{1}{2} = \frac{(36 \times 3) + 18(36 - 1) \times 3r}{1 + 36r}$
$1\frac{1}{2}^2 = \frac{108 + 630 \times 3r}{1 + 36r}$
$\frac{9}{4} = \frac{36 + 630r}{1 + 36r}$
$65 + 2340r = 72 + 1260r$
$2340r - 1260r = 72 - 65$
$1080r = 7$
$\therefore r = \frac{7}{1080}.$

$\therefore$ Rate per cent. per annum
$= \frac{7 \times 12 \times 108}{1080}$
$= \frac{9}{9}$
$= 7\frac{1}{2}$. Ans.

General.

1. CATERHAM.—We cannot reply to anonymous communications.

2. J. B.—A balloon is carried along by a current of air moving from E. to W. at the rate of 60 miles an hour, having no motion of its own through the air, and a feather is dropped from the balloon. What sort of path will it appear to describe as seen by a man in the balloon? (*London Matriculation*, 1874.)



Whilst the balloon has moved from B_1 to B_2, the feather has had the double motion of westward by the wind, and downwards by gravity. Since it will have passed as far west as the balloon, at any moment the feather will seem vertically below an observer in the balloon.

Hence the path of the feather will seem vertically downwards to a man in the balloon.

3. E. W. Rosser.—2·0876 grams of hydrogen when passed over heated oxide of copper yield 18·7406 grams of water. Calculate the atomic weight of oxygen.

The change that goes on is represented thus:

$$CuO + H_2 = Cu + OH^2,$$

or two atoms of hydrogen unite with one of oxygen.

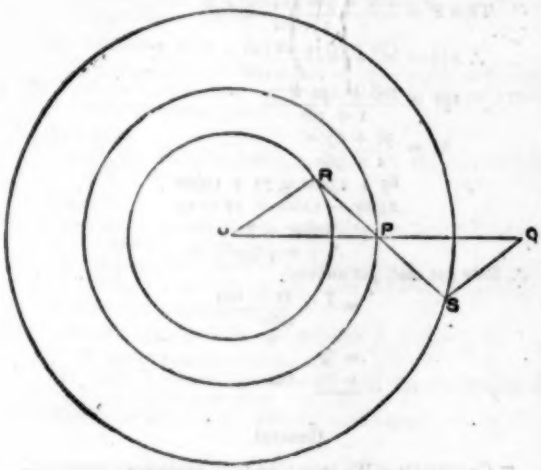
Now 2·0876 of H gave 18·7406 of water

$\therefore$ 2 of H give $\frac{18{\cdot}7416 \times 2}{2{\cdot}0876}$ of water.

Hence if we call the atomic weight of H unity, that of O will be 15·9.

Geometry.

1. T. H.—Three concentric circles are drawn in the same plane; draw a straight line, such that one of its segments between the inner and outer circumference may be bisected at one of the points at which the straight line meets the middle circumference. (*Todhunter.*)



Let O be the common centre.

Take any point P on the circumference of the middle circle; join OP, and produce it to Q, making PQ equal to OP.

With centre Q and radius equal to that of the smallest circle, describe a circle, and let one of the points at which it meets the outermost circle be S.

Join QS, and from O draw OR a radius of the inner circle parallel to QS.

Join SP, PR.

Then RPS shall be a straight line and shall be bisected at P.

Proof.—In $\triangle$s SPQ, RPO.

side SQ = side RO (Con.)
,, QP = ,, OP (,,)
And $\angle$ SQP = $\angle$ ROP, (I. 29.)
$\therefore$ Base SP = base RP
And $\angle$ SPQ = $\angle$ RPO (I. 4.)

Add $\angle$ OPS to each of the angles SPQ, RPO,

Then $\angle$s SPQ, SPO = $\angle$s RPO, OPS,

But $\angle$s SPQ, SPO are together equal to two right angles, (I. 13.)

$\therefore$ $\angle$s RPO, OPS are together equal to two right angles.

Wherefore RS is a straight line. (I. 14.)

$\therefore$ The straight line RS is bisected at P. Q. E. F.

Arithmetic.

1. Working Teacher.—The difference in age between A and B is $3\frac{1}{2}$ per cent. of A's age, and in $8\frac{1}{2}$ years will be 3 per cent. of A's age: find B's present age, he being supposed older than A.

$\frac{3\frac{1}{2}}{100}$ of A's age = $\frac{3}{100}$ of (A's age + $8\frac{1}{2}$ years)

$3\frac{1}{2}$ times A's age = 3 times A's age + 25 years

$\therefore$ A's present age = 50 years.

$\frac{1}{2}$ A's age = 25 years

$\therefore$ B's present age = 50 years + $\frac{3\frac{1}{2}}{100}$ of 50 years

= (50 + $1\frac{3}{4}$) years

= $\underline{51\frac{3}{4}}$ years. Ans.

QUARTERLY ARITHMETICAL TESTS—*contd.*

Standard V.—First Quarter.

1. How much are ninety-seven thousand envelopes worth at $9\frac{1}{2}$d. per hundred?

2. Find the value of 16 tons 9 cwt. 3 qrs. 22 lbs. at £6 3s. 8d. per cwt.

3. What is the value of 2,706 articles at £37 16s. $0\frac{3}{4}$d. each?

4. I was offered a guinea and a-half for 5 bus. 3 pks. 1 gal. of corn, but I sold it at the rate of £2 5s. 4d. per quarter; how much did I gain or lose by rejecting the offer?

Second Quarter.

1. What is the income of a person who pays £15 9s. for income-tax, when an income of £300 pays £7 10s.?

2. Three lots of ground are sold, containing respectively $59\frac{1}{2}$ acres, $76\frac{1}{4}$ acres, and 39 acres 12 poles; £12 7s. 10d. per acre was paid for the first lot, £13 15s. 9d. for the second, and £16 18s. 4d. for the third; what was the price of the whole?

3. What weight should be carried 187 miles for the same sum for which 29 tons 14 cwt. are carried 119 miles?

4. Make out a bill for:—

1 cwt. of tobacco at $2\frac{1}{4}$d. per oz.;
2 tons of sugar at $4\frac{5}{8}$d. per lb.;
$3\frac{1}{2}$ cwt. of treacle at $1\frac{1}{4}$d. per lb.;
$2\frac{3}{4}$ cwt. of cheese at 6s. 9d. per dozen lbs.;
A tub of butter (containing $74\frac{1}{2}$ lbs.) at £4 18s. per cwt.

Third Quarter.

1. What part of a cheese is left after selling $\frac{3}{9}$, $\frac{8}{11}$, and $\frac{5}{12}$ of it?

2. If sugar be bought at £1 9s. 6d. per cwt., and retailed at $4\frac{1}{2}$d. per lb., what is the profit on a cask containing 7 cwt. 1 qr. 14 lbs.?

3. A boy ate $\frac{2}{5}$ and then $\frac{3}{8}$ of a loaf. How much more must he eat so that there shall be left only $\frac{1}{10}$?

4. After paying an agent 6d. in the pound, my net receipts for rents came to £390; what was the total amount paid by the tenants?

Standard VI.—First Quarter.

1. Simplify:—

$$\frac{3\frac{1}{2}}{4\frac{2}{3}} + \frac{1\frac{2}{5} \times 3\frac{3}{4}}{5\frac{1}{7} \div 7\frac{1}{3}}.$$

2. What vulgar fraction is equal to $\cdot3\dot{7} - \cdot0\dot{8}1$?

3. Divide £76 13s. 6½d. by $1\frac{5}{9}$ of $2\frac{3}{7}$.

4. Find the continued product of ·0078, ·00078, and ·oc0078.

Second Quarter.

1. Add together ·375 of £2 15s., ·095 of £10, and ·8 of half-a-crown; reduce the sum to the decimal of 30s.

2. After paying an income-tax of 4d. in the £, a person had £637 18s. 9d. left; what was the amount of his income?

3. How many yards are there in 17·4375 of 9½ miles?

4. If $\frac{3}{10} + \frac{3}{15} + \frac{6}{25}$ of an estate is worth £18,079, what is the value of the whole estate?

Third Quarter.

1. If $\frac{7}{8}$ of $\frac{3}{10}$ of 40 yards cost £4 2s. 3d., what would be the cost of $\frac{5}{8}$ of $\frac{7}{15}$ of 42 yards?

2. What amount will be received at the end of $3\frac{1}{2}$ years by a person who places £7,982 10s. in a bank at 3 per cent.?

3. If the 5d. loaf weigh 3·5 lbs. when wheat is 1·6s. per stone, what ought it to weigh when wheat is 1·75s. per stone?

4. What principal will amount to £105 12s. in 7 years at 4 per cent.?

Standard VII.—First Quarter.

1. In what time will £780 gain £20 9s. 6d. at 3½ per cent.?

2. A farmer lets three farms of 84 a. 2 r., 76 a. 1 r., and 159 a. 3 r., the first at 25s. an acre, the second at 30s., and the third at 35s. What is the average rent per acre?

3. A bankrupt owes £389 10s., £476 15s., and £670 18s. 4d. His assets are worth £960 14s. 7d.; what will be the dividend?

4. A grocer sold ¾ ton of sugar at 2 lbs. for 3½d., and ¼ ton at 2 lbs. for 4½d. What was the average price per lb.?

Second Quarter.

1. An article was sold for £2 18s. at a gain of 16 per cent.; what would be the selling price if 20 per cent. had been gained?

2. A cistern can be filled by a pipe in 4 hours and emptied by another pipe in 3 hours. If the cistern is full, and the second pipe is opened at 4 p.m., and the first at 5 p.m., when will the cistern be empty?

3. If 48 lbs. of tea at 1s. 8d. per lb. are mixed with 60 lbs. at 2s. 4d. per lb., at what price per lb. should the mixture be sold to gain 12½ per cent.?

4. A dealer bought boxes of eggs at 35s. each, and sold them at a gain of ⅛ of the *selling* price; what was the gain per cent.?

Third Quarter.

1. What is the price of the Three-and-a-Quarter per Cents. if £13,440 produces an income of £455?

2. At what rate per cent. will £547 10s. amount to £550 17s. 6d. in 50 days?

3. By investing in the Three-and-a-Half per Cents. at 89¾ my income is £395 10s. What sum do I invest, brokerage being ⅛ per cent.?

4. If 8 per cent. is lost by selling a piano for £36 16s., what per cent. will be gained by selling it for £43 12s.?

ANSWERS.

Standard I.

First.	Second.	Third.
1. 808.	1,408.	2,493.
2. 436.	494.	78.
3. 453.	106.	189.
4. 22 nuts.	258 children.	21 eggs.

Standard II.

First.	Second.	Third.
1. 28,395.	9,147.	7,896.
2. 121,545.	83,509,220.	5,187.
3. 2,661,514.	7,905.	18,877,222.
4. 7,275 pounds.	43,616 pages.	23,814 marbles.

Standard III.

First.	Second.	Third.
1. 8,474 + 34.	£524 10s. 8½d.	£49,229 5s. 8¾d.
2. 698 times.	29 gallons.	59 pages.
3. 4,416,994.	£10,394 10s. 10½d.	£17,918 18s. 9¾d.
4. 39 nuts.	£33 3s. 3d.	Sheep, £2 9s.; goat, £1 15s.; pig, £2 16s.

Standard IV.

First.	Second.
1. £2,326 15s. 1¾d.	£10 16s. 8d.
2. £371,419 11s. 8¼d.	2,515,374 inches.
3. £1,035 7s. 8¾d.	11 a. 1 r. 36 sq. po. 16 sq. yds.
4. £4 7s. 9d.	5 sq. ft. £5 6s. 8d.

Third.

1. rs.
2. 791 qrs. 7 bus. 3 pks. 1 gal.
3. 2,760 stones.
4. 1,600 days.

Standard V.—First.

1. £38 7s. 11d.
2. £2,040 3s. 4½d.
3. £102,295 5s. 1½d.
4. 1s. 9½d. gain.

Second.

1. £618.
2. £2,449 12s. 4¾d.
3. 18 tons 18 cwt.
4. £16 16s. + £84 + £2 0s. 10d. + £8 13s. 3d. + £3 5s. 2½d. = £114 15s. 3½d.

Third.

1. $\frac{33}{175}$.
2. £4 12s. 2¼d.
3. $\frac{47}{175}$.
4. £400.

Standard VI.

First.	Second.	Third.
1. $9\frac{1}{16}$.	1·3875.	£4 15s. 11½d.
2. $\frac{404}{1155}$.	£648 15s.	£8,820 13s. 3d.
3. £20 5s. 11½d.	291,555 yards.	3½ lbs.
4. ·000000000474552.	£26,850.	£82 10s.

Standard VII.

First.	Second.	Third.
1. 9 months.	£3.	96.
2. £1 11s. $2\frac{22}{221}$d.	1 a.m.	4½ per cent.
3. 12s. 6d.	2s. 3½d.	£10,155 17s. 6d.
4. $1\frac{1}{48}$d.	40 per cent.	9 per cent.

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